

# IMPROVED PARAMETERIZATIONS IN THE GPM COMBINED ALGORITHM

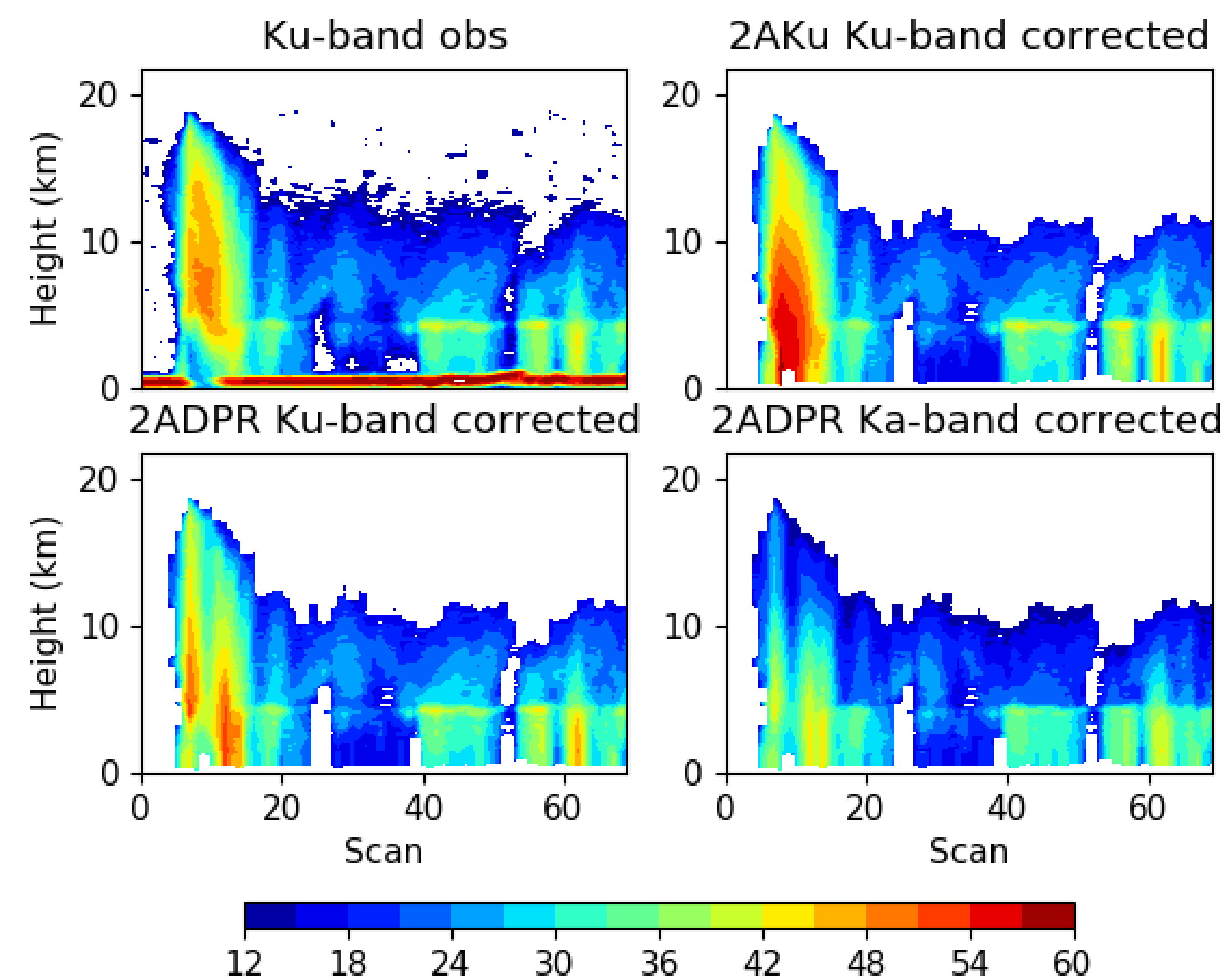
MIRCEA GRECU<sup>1</sup> AND WILLIAM S. OLSON<sup>2</sup>  
Morgan State University (1), UMBC (2), and NASA GSFC

## PROBLEM

Various parameterizations are incorporated in Version 6 of the GPM combined algorithm to mitigate uncertainties such as: multiple scattering, Non-Uniform Beam Filling and spatial variability of particle size distribution parameters. Despite these parameterizations, several deficiencies are still apparent. These include

1. The joint distribution of retrieved  $N_w$   $D_m$  are systematically different from those derived from GV observations.
2. The monthly surface precipitation estimates at high-latitudes appear to be systematically lower than those derived from other observations.

Further insight into these deficiencies can be derived through an rigorous analysis of cases that exhibit the physical processes conducive to uncertainties in retrievals (e.g. multiple scattering, NUBF, etc.). Shown below are the Ku-band observed reflectivities for a storm over Africa in March 2014. While the GPM.Ku algorithm provides realistic attenuation correction, the GPM.DPR algorithm produces unrealistic correction due to multiple scattering.



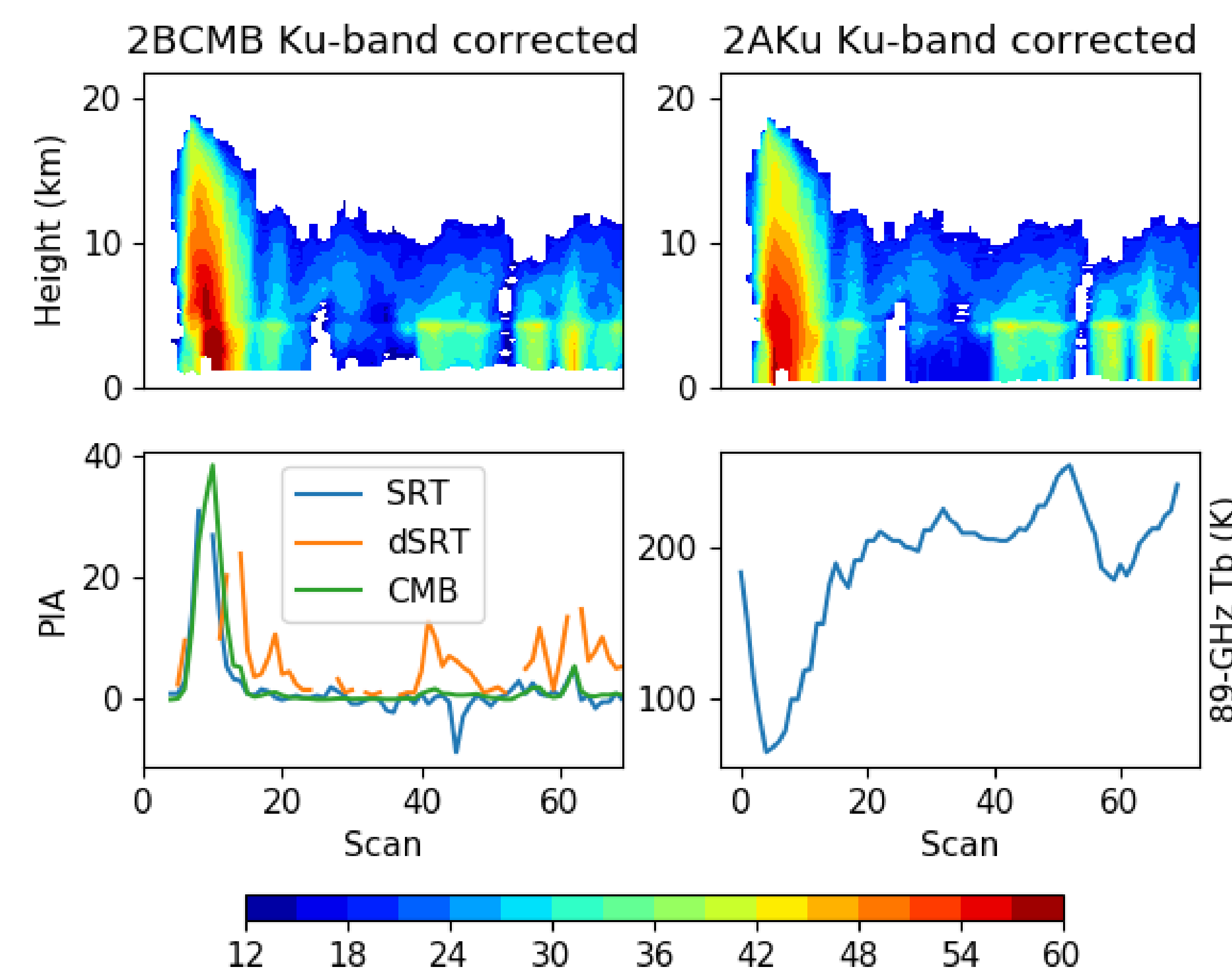
## OBJECTIVES

Objectives of this investigation are:

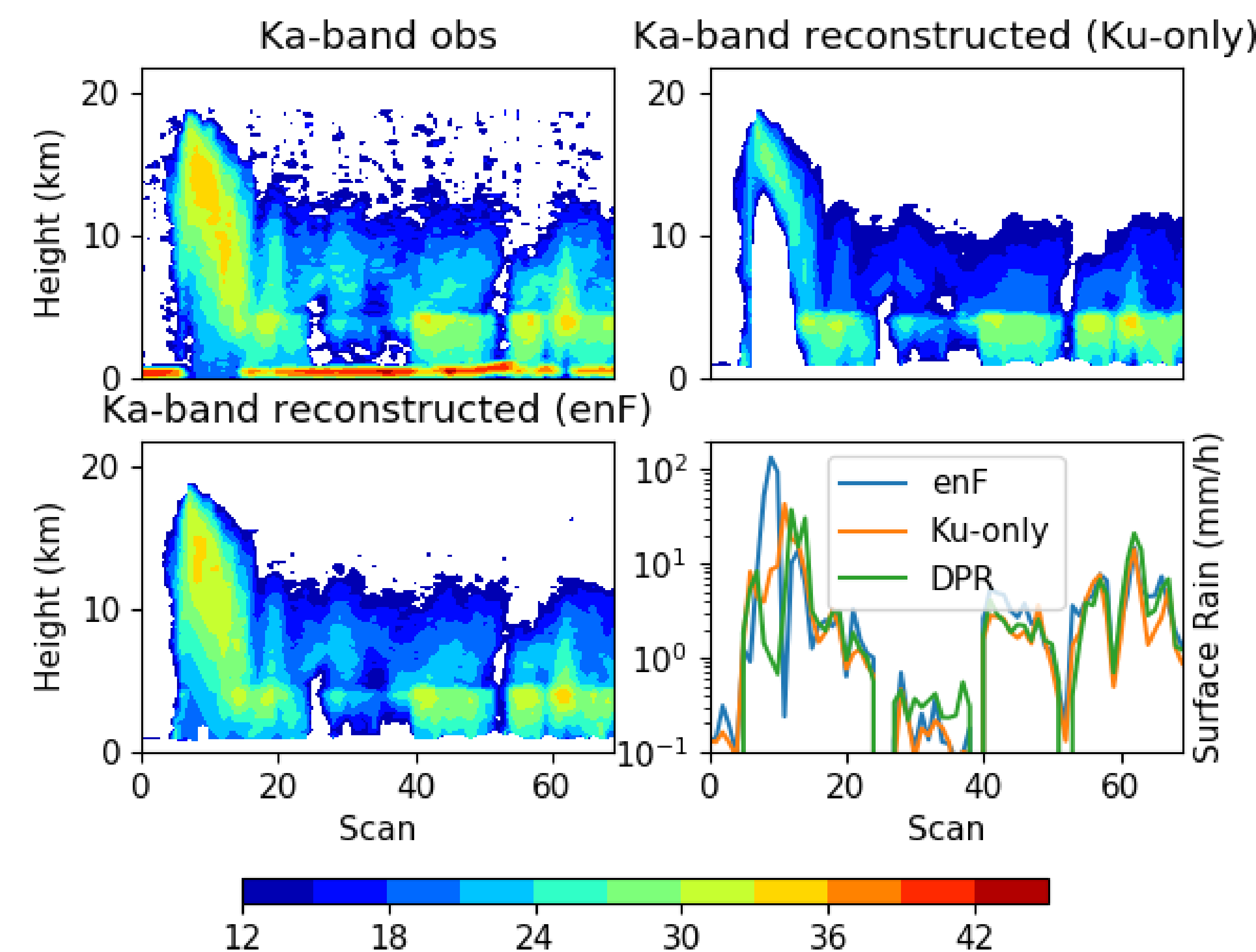
1. Investigate how well the Ka-band reflectivities are reconstructed by the GPM combined algorithm and derive the best combination of tools and parameterizations that produces realistic  $N_w$  -  $D_m$  distribution.
2. Investigate the relationships between GMI and delta PIA observations over oceans.
3. Derive numerical procedure to estimate Ku-band PIA from GMI observations and investigate its utility in quantifying the light rain over oceans.

## APPROACH

The impact of the Ka-band observations of the  $N_w$ - $D_m$  relationships has been preliminarily study last year (prior to the adaptation of the GPM Combined algorithm to TRMM observations). Although an improvement was noticed in the observations, it was not determined whether this was exclusively due to the ingestion of the SRT delta-PIA information. Also, the agreement between observed and reconstructed Ka-band observations was not explicitly investigated. Shown below are the CMB and GPM.Ku attenuation corrected observations at Ku-band. Shown are also the SRT PIA and delta-PIA and the observed 89-GHz brightness temperature.

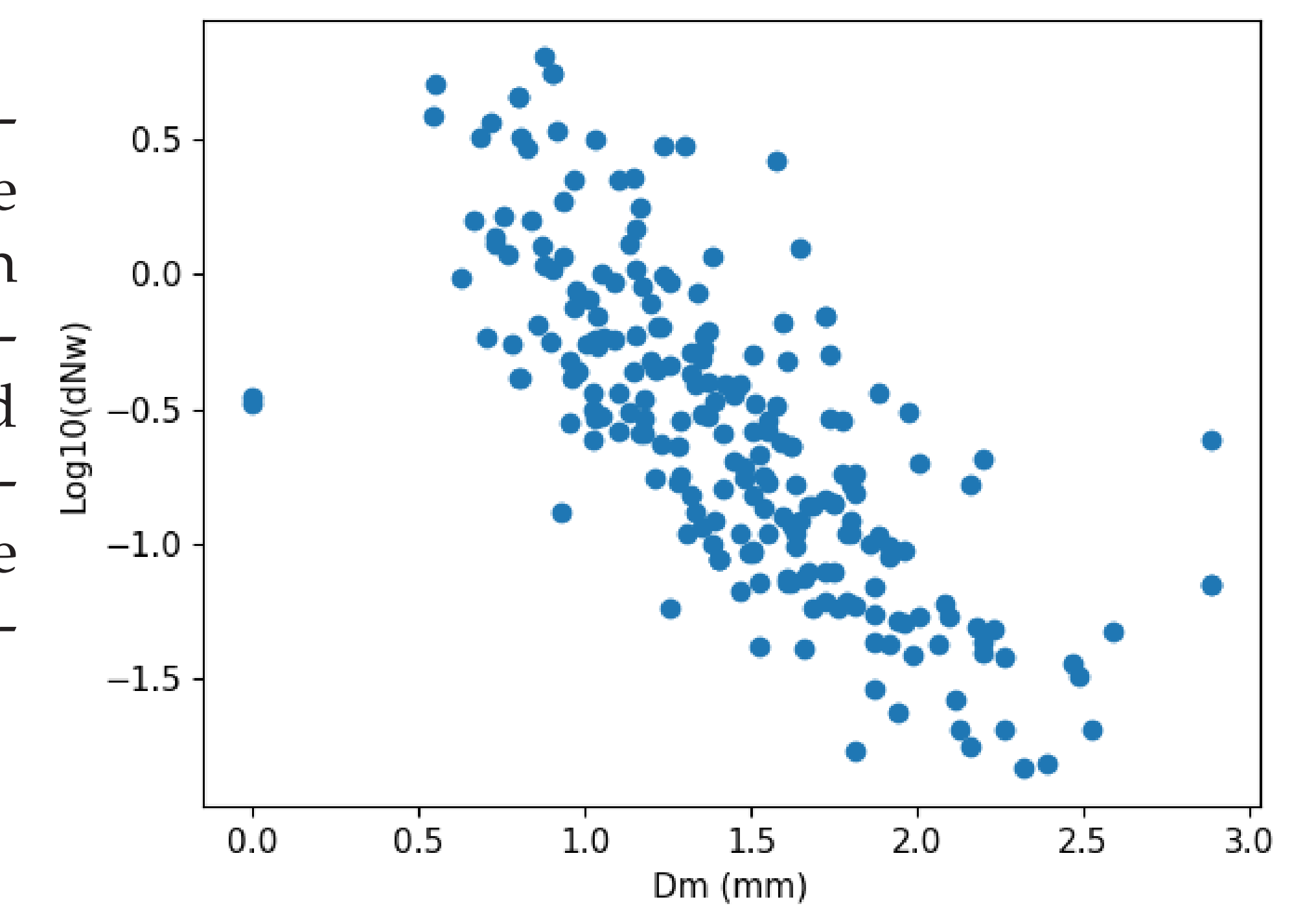


The reconstructed Ka-band reflectivity observations from Ku-band and dual frequency observations is indicative of the impact of Ka-band observations on the final estimates. Multiple scattering effects were ignored in the Ku-band only reconstruction.



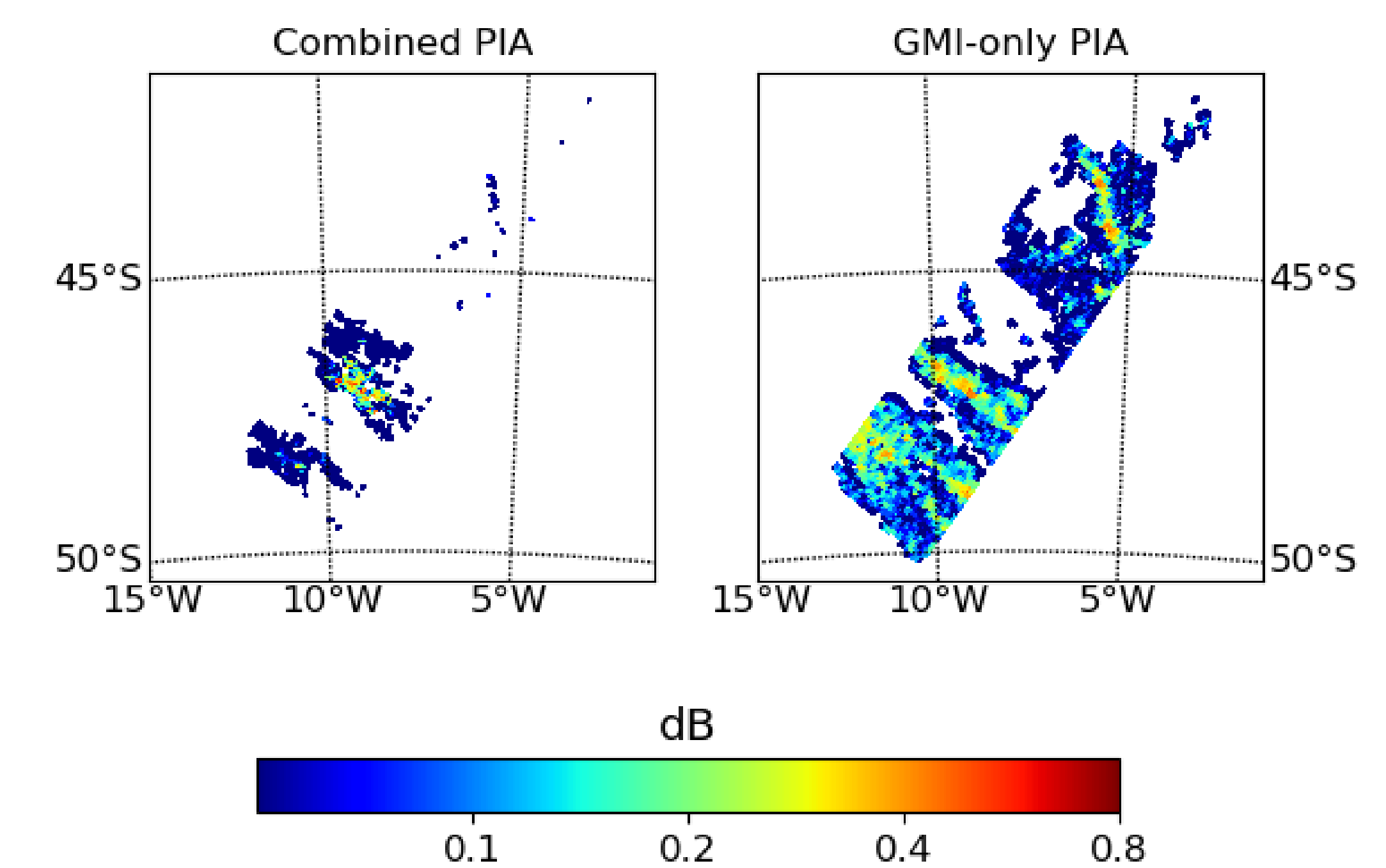
## IMPROVED $N_w$ - $D_m$ RELATIONSHIPS

Improved  $N_w$ - $D_m$  distributions can be derived through a tighter optimization aimed at better minimizing the objective function.



## RADIOMETER DETECTION OF LIGHT RAIN

(Left) Ku-band PIA estimated by the current CMB algorithm. (Right) Ku-band PIA derived from GMI observations



## CONCLUSIONS

1. The Ensemble Filter approach provides a good fit of the Ka-band observations. The operational under-adjustments of the  $N_w$  parameter are most likely caused by unrealistically large uncertainties and ensemble spreads.
2. There GMI observations and the SRT delta-PIA are strongly correlated over oceans. These correlations can be used to detect light rain over oceans.

## ACKNOWLEDGMENTS

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